

FOOD HABITS OF THE RED PANDA, *AILURUS FULGENS* IN THE SINGHALILA NATIONAL PARK, DARJEELING, INDIA¹

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(With one text-figure)

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Food habits of the red panda in the Singhalila National Park (SNP) were investigated at three sites from 1994 to 1996, by examining 1,250 droppings or faeces. Red panda was found to consume two species of bamboo, *Arundinaria maling* and *A. aristata*, which dominated the understorey of SNP, along with seasonal supplements of some fruits and shoots of the above mentioned bamboo species. However, the composition of the diet differed between the sites. The difference in their dietary composition in relation to the overall ecology of the red panda in the SNP needs further investigation.

INTRODUCTION

The red panda belongs to the Order Carnivora, but interestingly subsists on a herbivorous diet, specifically on bamboo leaves. Although the modifications of dentition and skull structures have typical herbivorous features, the digestive system is ill-adapted for proper utilization of its low nutrient diet of bamboo (Roberts and Gittleman 1984, Bleijenberg and Nijboer 1989). The gut is short and simple, typical of the carnivores, and devoid of cellulose digesting microbes (Roberts and Gittleman 1984, Schaller *et al.* 1985). As a result, the red panda consumes a large amount of bamboo to fulfill its energy requirement (Ofstedal *et al.* 1989). The red panda has evolved a physiological adaptation of lowering the metabolic rate to cope with low nutrient diet, reducing energy expenditure for maintenance and reproduction (McNab 1989). This evolutionary strategy results in a long

gestation period, low fecundity and slow postnatal growth, which place constraints on the rapid propagation of its population (McNab 1989). Moreover, the bamboo mass flowers periodically, and dies after the seeds are produced (Janzen 1976). The panda faces scarcity of food during the flowering stage of the bamboo. This paper presents preliminary findings on the food and feeding habits of red panda studied during a research project (1993-1996) in the Singhalila National Park (SNP), Darjeeling, eastern Himalaya, India.

STUDY AREA

The SNP (87° 59'-88° 53' E; 26° 31'-27° 31' N) ranges from 2,400 to 3,600 m above msl, encompassing the temperate zone and subalpine zones. The moist temperate climate of SNP varies with altitude. The observed summer temperature ranged from 7 to 17 °C, and winter temperature dropped as low as 1 °C in the temperate zone. Average summer and winter temperature in the subalpine region were 7 °C and 1 °C respectively. Mean annual rainfall was 350 cm and average humidity ranged from 83% to 96%.

The intensive study area comprised of three sites (Fig. 1). Sites 1 and 2 represented the

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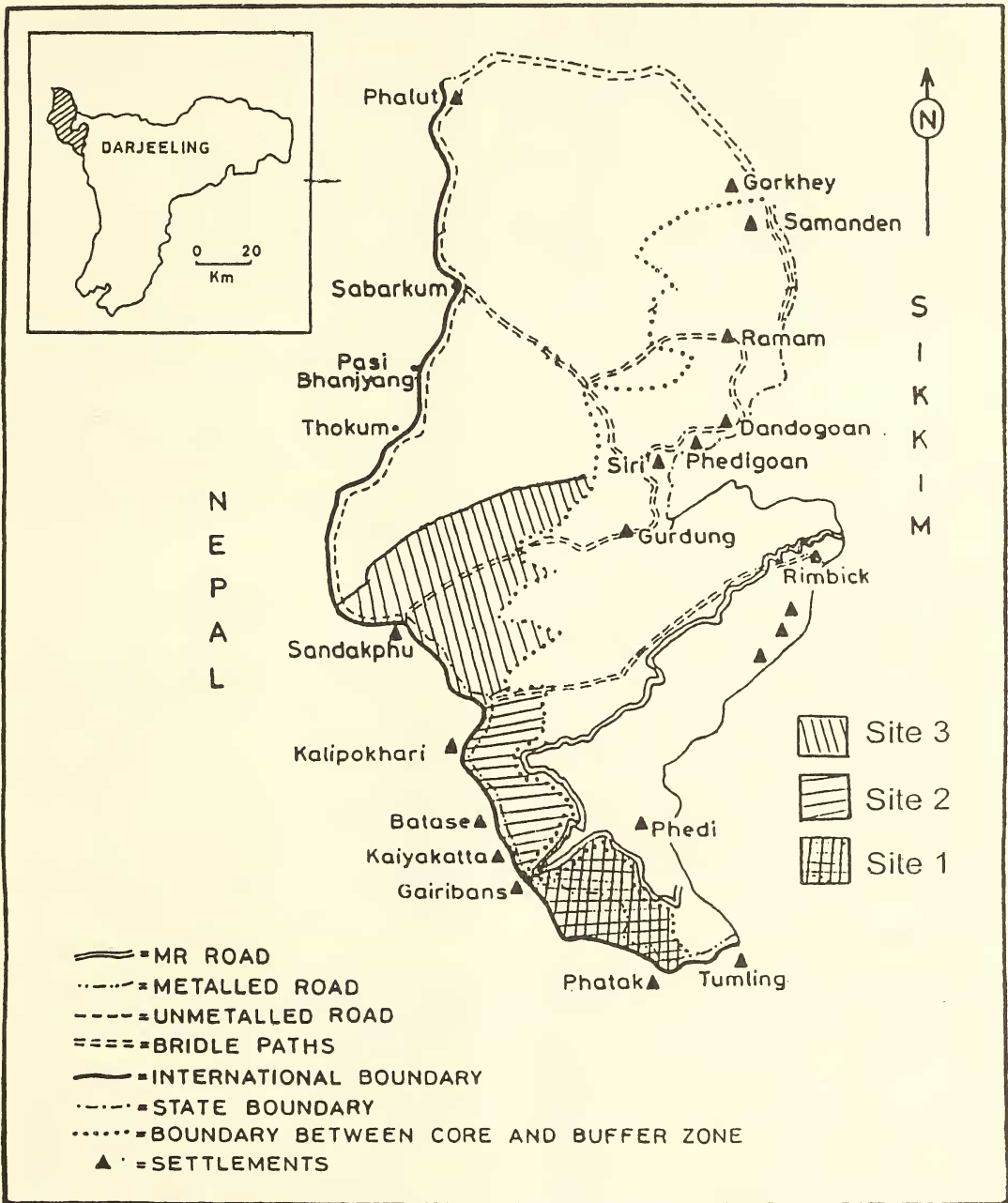


Fig. 1: Singhalila National Park, Darjeeling, India.

temperate zone, and Site 3 the subalpine zone. Trees such as *Quercus* spp. dominated the temperate zone, *Arundinaria maling* being dominant in the understory. In the higher reaches of the temperate zone, *Quercus* spp. were scarce, and the vegetation was dominated by *Sorbus*, *Acer* and *Vitex*. The understory was composed of both *Arundinaria maling* and *A. aristata*. The subalpine zone had a prominent association of trees such as *Abies densa*, *Betula utilis* and *Rhododendron* spp., with an understory of *A. aristata*.

METHODS

Red panda food habits and nutritional status of food plants were investigated by the following methods:

Phenology of the food plants: In order to investigate the availability of cover and food resources in the study area, phenological studies were undertaken (Pradhan 1999). The fruiting seasonality of the food plants is presented here. Phenology and recruitment rates of the two bamboo species were studied in sixty 1 sq. m plots, thirty each for the two species. Initially, all the bamboo culms in the 1 sq. m plots were counted and monitored monthly. When the shoots appeared, they were counted and labelled. After that, all the labelled shoots were monitored to assess their survival and death.

Faecal analysis: Red panda pellets were collected monthly, broken and macroscopically examined. While the leaves of the two bamboo species could be identified macroscopically, the shoots of both the species were not identifiable. The fruits and berries consumed were identified from the seed remains, undigested skin of the fruits and even sheaths, which survived digestion. Each food item was expressed by its frequency of occurrence and by percent volume, computed for each season from the entire study area. Thus, the diet spectrum of red panda was also

investigated for the three study sites within two broad vegetation zones — the temperate and subalpine zones separately. The difference in intake of two bamboo species was tested using Mann-Whitney U test following Fowler and Cohen (1986).

Nutritional analysis: Leaves of both species of bamboo, of all age classes (1 year, 2 year, and >2 years), were collected every month for a year. Fruits of *Actinidia strigosa*, *Sorbus microphylla* and *Rosa* spp., and shoots of both bamboo species were collected during their season of emergence. All the plant samples were dried to a constant weight at 55 °C and ground in Willey's mill prior to analysis. Hemicellulose, cellulose and lignin were determined following Goering and Van Soest (1970), using Fibertech System. Crude protein was determined following Allen (1989).

RESULTS

A total of 1,250 pellets were examined. It was found that the red panda in the SNP consumed both the species of bamboo. The difference between the intake of the leaves of the two species was, however, not statistically significant (Mann-Whitney; $z = 0.24$, $df = 12$, $p = 0.813$). Along with the bamboo leaves, some seasonal fruits and shoots of the bamboo species were also consumed by the red panda.

Availability and distribution of food: The bamboo species *A. maling*, locally known as *maling* had an average height of 4.9 ± 0.80 m and a diameter of 1.5 ± 0.73 cm. The average number of nodes was 22 with an average sheath length of 22 cm. *A. aristata*, locally known as *ratonigalo* was shorter, with an average height of 3.9 ± 0.053 m. The average number of nodes was 22; average sheath length 12.81 cm. *A. aristata* had a higher density of culms than *A. maling*.

A. maling was the dominant bamboo

between 2,600 m to 3,100 m in the study area. *A. aristata* was found from 2,850 m, but actually dominated the understory from 3,150 m to 3,600 m. Shoots of *A. maling* appeared annually between early June and October, whereas the shoots of *A. aristata* emerged from late June to October. The recruitment rate of bamboo (*A. maling* and *A. aristata*) was low, with an average of 1.92 /sq. m, out of which only 0.98 /sq. m remained intact. Of the bamboo shoots monitored, 48% were eaten by insects and other animals, and 9.8% were broken accidentally. The bamboo shoots collected by the locals was 10.96 kg/family.

In the temperate zone, the fleshy fruit of *Actinidia strigosa*, a creeper was found to be an important component of the red panda's post-monsoon diet. *A. strigosa* was found between 2,800 m and 3,100 m in the study area. *A. strigosa* started fruiting from September, matured around October, and the fruits lasted till November. The fruits of *A. strigosa* had a thin skin and were sweet when ripe, they were much sought after by the locals to add flavour to their liquor. An estimated amount of approximately 3.75 kg/family was collected by the locals during its fruiting season. *Sorbus microphylla* started fruiting from June to July and was found from 3,200 m to 3,600 m. *Rosa sericera*, a shrub in disturbed areas, fruited from June to November.

Seasonal variation in diet: The diet of the red panda in SNP varied seasonally (Table 1). In pre-monsoon, its diet was a combination of 52% *A. aristata* and 48% *A. maling* leaves by volume. In the monsoon, it fed on *A. aristata* and *A. maling* leaves, bamboo shoots and traces of an unidentified fruit. In post-monsoon, food variety increased with the availability of fruit resources in the forest. Red panda was found to consume *A. aristata* leaves (45%), *A. maling* leaves (35%), fruits of *Actinidia strigosa* (13%) bamboo shoots (6%), *Sorbus microphylla* and *Rosa sericera* in trace amounts. The winter diet consisted of *A. aristata* leaves (53%) and *A. maling* (47%).

The overall intake of *A. aristata* varied from 34.86% to 53% ($x = 45.97\%$), while *A. maling* varied from 36.18% to 48.16% ($x = 41.97\%$), and the rest ($x = 11.82\%$) consisted of fruits and bamboo shoots. No evidence of large scale carnivory was found in the faecal pellets, except for a few bird feathers.

Feeding ecology in the three study sites: The diet showed seasonal differences in proportions of different food items consumed at the three study sites (Table 2). At Site 1, it comprised of *A. maling* leaves (100%) in the premonsoon and winter seasons. In the monsoon, it fed on *A. maling* leaves (61%), bamboo shoots (38%) and unidentified fruit (1.1%). The post-monsoon diet was composed of *A. maling* leaves (70%), *A. strigosa* fruits (20%)

TABLE 1
INCIDENCE OF FOOD ITEMS IDENTIFIED IN 1,250 RED PANDA DROPPINGS BY NUMBER OF DROPPINGS AND % VOLUME (IN BRACKETS) IN SINGHALILA NATIONAL PARK

Food items	Pre-monsoon (Mar-May)		Monsoon (June-Aug)		Post-monsoon (Sept-Nov)		Winter (Dec-Feb)	
<i>Arundinaria maling</i>	295	(48.16)	98	(36.18)	120	(34.57)	85	(47.0)
<i>Arundinaria aristata</i>	385	(51.84)	80	(34.86)	105	(44.70)	112	(53.0)
Bamboo shoots	0	(0)	53	(28.58)	22	(6.23)	0	(0)
<i>Actinidia strigosa</i>	0	(0)	0	(0)	27	(13.33)	0	(0)
<i>Sorbus microphylla</i>	0	(0)	0	(0)	0.6	(0)	0	(0)
<i>Rosa sericera</i>	0	(0)	0	(0)	1.0	(trace)	0	(0)
Unidentified fruit	0	(0)	0	(0)	10	(trace)	0*	(0)
Total number of droppings	632		188		235		195	

Trace = less than 1.00%

TABLE 2
SEASONAL INCIDENCE OF FOOD ITEMS IN RED PANDA DROPPINGS BY NUMBER OF DROPPINGS AND % VOLUME (IN BRACKETS) FROM THREE STUDY SITES IN SINGHALILA NATIONAL PARK

Food items	Site 1				Site 2				Site 3			
	PR	MN	PM	W	PR	MN	PM	W	PR	MN	PM	W
<i>Arundinaria maling</i>	122 (100)	68 (60.6)	90 (70)	52 (100)	156 (45.5)	42 (38.8)	35 (33.8)	33 (41)	0 (0)	0 (0)	0 (0)	0 (0)
<i>Arundinaria aristata</i>	0 (0)	0 (0)	0 (0)	0 (0)	111 (54.4)	38 (46)	24 (44)	35 (59)	270 (100)	42 (74.6)	85 (91)	77 (100)
Bamboo shoots	0 (0)	30 (38.3)	8 (10)	0 (0)	0 (0)	24 (15.3)	9 (2.2)	0 (0)	0 (0)	10 (25.3)	7 (6.7)	0 (0)
<i>Actinidia strigosa</i>	0 (0)	0 (0)	0 (20)	0 (0)	0 (0)	0 (0)	9 (20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
<i>Sorbus microphylla</i>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1.73)	0 (0)
<i>Rosa sericera</i>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (trace)	0 (0)
Unidentified fruit	1 (trace)	8 (1.1)	10 (trace)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total droppings	122	68	97	52	240	79	53	65	270	42	85	77

Trace = less than 1.00%

PR= Pre-monsoon, MN=Monsoon, PM = Post-monsoon, W = Winter

and bamboo shoots (10%).

At Site 2, red panda was found consuming *A. aristata* (54%) and *A. maling* (46%) leaves in premonsoon, and about the same proportion of the same leaves in winter. The monsoon diet was composed of *A. aristata* leaves (46%), *A. maling* leaves (39%) and bamboo shoots (15%), while the postmonsoon diet was *A. aristata* (44%), *A. maling* (34%) leaves, *A. strigosa* (20%) and bamboo shoots (2%).

At Site 3, the diet consisted entirely of *A. aristata* leaves (100%) during premonsoon and winter. In the monsoon, the pellets were found to have *A. aristata* leaves (75%) and bamboo shoots (25%). Postmonsoon samples of Site 3 consisted of *A. aristata* leaves (91%), bamboo shoots (6.7%), *S. microphylla* (1.73%) and *R. sericera* in trace amounts of 0.57%.

Nutritive value of the food plants:

A. maling leaves were found to have higher cellulose and lignin content (40.12% of the dry matter) than *A. aristata* (31.83%). The crude protein and lignin content of *A. maling* leaves

was 15.1 % and *A. aristata* leaves was 14.2%. Fruits of *A. strigosa* seem to be nutritionally richer, with high and crude protein, and low cellulose and lignin content, as compared to *S. microphylla* and *R. sericera* (Table 3).

DISCUSSION

Macroscopic examination of faeces, as done in this study, has also been used successfully by Reid *et al.* (1991), and Yonzon and Hunter (1991) in describing the red panda's diet. Red panda consumed both the species of bamboo present in the SNP, which formed the chief food,

TABLE 3
PROTEIN, HEMICELLULOSE, CELLULOSE AND LIGNIN CONTENT (% DRY MATTER) OF THREE FRUITS EATEN BY THE RED PANDA IN SINGHALILA NATIONAL PARK

Fruit	Crude Protein	Hemicellulose	Cellulose+lignin
<i>Actinidia strigosa</i>	10.63	8.00	20.59
<i>Sorbus microphylla</i>	4.38	2.54	41.00
<i>Rosa sericera</i>	8.88	1.95	28.01

especially during the premonsoon and winter periods. Seasonal fruits such as *A. strigosa* and *S. microphylla*, and bamboo shoots supplemented the diet of bamboo leaves during the monsoon and the postmonsoon period. The monsoon and postmonsoon coincided with the period of birth and rearing of the young of red panda. Earlier studies specify leaves and shoots of *Sinarundinaria fangiana*, and shoots of *Fargesia spathecea* to be taken in the Wolong Nature Reserve (China), (Schaller *et al.* 1985, Johnson *et al.* 1988, Reid *et al.* 1991) and a species of bamboo locally known as *jhapra* in the Langtang National Park, Nepal (Yonzon and Hunter 1991). Fruits and berries of *Sorbus* spp., *Maddenia hypoleuca*, *Cotoneaster moupinensis*, *Clematoclethera tiliaceae*, *Rubus mesogaesus*, *R. pileatus*, *Ribes moupinense*, *Prunus vaniotti* and *P. brachyoda* and even mushrooms are reported to be taken by the red panda in the wild (Johnson *et al.* 1988, Reid *et al.* 1991, Yonzon and Hunter 1991).

Feeding ecology in the three study sites of SNP: The amount of *A. aristata* leaves taken by the red panda in the SNP was slightly higher than *A. maling*, although the difference is not statistically significant. It was not possible to say how particular they were about selecting the bamboo species. Red panda was found to be consuming mainly *A. maling* leaves in Site 1, the dominant species in the area, as *A. aristata* was found only in patches above 2,850 m. At Site 2, both *A. maling* and *A. aristata* leaves were consumed because of the increasing availability of *A. aristata* as compared to that in Site 1. At Site 3, the diet was solely composed of *A. aristata* leaves, the dominant bamboo species of the area.

The giant panda selected *Sinarundinaria* sp. over *Fargesia* sp. in the Choushuigou study area in China, where both species were easily accessible, perhaps due to the higher protein, other nutrients and less cellulose, lignin and better balance of essential amino acids in *Sinarundinaria* sp. (Schaller *et al.* 1985).

However, the pandas in Jiuzhaigou (China) and elsewhere subsisted entirely on the *Fargesia* sp. which was regarded an adequate food (Schaller *et al.* 1985).

The topography of the study area was such that the two species of bamboo were not equally abundant in any of the three sites. *A. maling* dominated Site 1. At Site 2, both *A. maling* and *A. aristata* were found. *A. aristata* dominated Site 3. From the results of Site 1 and Site 3, it could be tentatively said that the red panda was consuming the species of bamboo most easily available. Investigation of the food quality of plants ascertained that *A. aristata* leaves had higher levels of protein, less of cellulose and lignin as compared to *A. maling*. However, not much could be inferred about the food preference on the basis of nutrient content, as *A. maling* and *A. aristata* leaves were taken in almost equal quantity at Site 2. Moreover, *A. maling* and *A. aristata* leaves seemed an adequate diet at Site 1 and Site 3 respectively.

Fruits of *A. strigosa* formed an important supplement to the red panda diet. However, more can be said of the selection of fruits only by comparing the preference and avoidance of other fruits found within a site rather than between sites. For example, within Site 1 and Site 2, other fruits, which the red panda may have consumed, were *Holbellia latifolia* and *Sorbus cuspidata*. But faecal examinations showed that these fruits were not taken, despite their abundance. The nutritional analysis of other fruits was beyond the scope of the present study.

Both species of bamboo have been affected by intensive cattle grazing, and they were also found to have low recruitment rate. The bamboo shoots of both *A. maling* and *A. aristata* were not only eaten by other wild animals, but also harvested by the locals. All these factors could have an effect on their growth dynamics and need further studies. *A. strigosa* is also harvested by the locals in significant quantity.

This study finally reveals that the diet of the red panda in the temperate zone consisted of *A. maling* and *A. aristata* leaves and shoots, and fruits of *A. strigosa*, whereas in the subalpine zone, *A. aristata* leaves, shoots and fruits of *S. microphylla* and *R. sericera* were consumed. The difference in the dietary composition in relation to the overall ecology of the red panda in the Singhalila National Park needs further study.

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REFERENCES

- ALLEN, S. (1989): Chemical analysis of ecological materials. Blackwell Scientific Publications, London. Pp. 368.
- BLIEJENBERG, M.C.K & J. NIJBOER (1989): Feeding herbivorous carnivores. In: Red panda Biology (Glatston, A.R. ed.) SPB Publishing, The Hague, Netherlands, pp. 41-50.
- FOWLER, J. & L. COHEN (1986): Statistics for Ornithologists. BTO Guide No. 22.
- GOERING, H & P. VAN SOEST (1970): Forage fiber analysis (apparatus, reagents, procedure and some applications). In: Agricultural Handbook, 379: 1-20. U.S. Dept. Agriculture.
- JANZEN, D. (1976): Why bamboos wait so long to flower. *Ann. Rev. Ecol. Syst.* 7: 347-91.
- JOHNSON, K.G., G.B. SCHALLER & H. JINCHU (1988): Comparative behaviour of red panda and the giant pandas in the Wolong Reserve, China. *J. Mammal* 69(3): 552-564.
- MCNAB, B.K. (1989): Energy expenditure in the Red panda. In: Red panda Biology (Glatston, A.R. ed.) SPB Publishing, The Hague, Netherlands, pp. 73-78.
- OFTEDAL, O., K.J. FULTON & S.D. CRISSEY (1989): Bamboo as a source of digestible energy for red pandas. *Int. Theriol. Congr. (Abstract) Rome, August 1989.*
- PRADHAN, S. (1999): Studies on some aspects of the ecology of the red panda (*Ailurus fulgens*, Cuvier 1825) in the Singhalila National Park, Darjeeling, India. Ph.D. thesis. North Bengal University, India.
- REID, D.G., H. JINCHU & Y. HAUNG (1991): Ecology of the red panda *Ailurus fulgens* in the Wolong Reserve, China. *J. Zool. Lond* 225: 347-364.
- ROBERTS, M.S. & J.L. GITTLEMAN (1984): *Ailurus fulgens*. Mammalian species. *The American Society of Mammalogists* 222: 1-8.
- SCHALLER, G.B., H. JINCHU, P. WENSHI & Z. JING (1985): The giant pandas of Wolong. The University of Chicago Press, Chicago. Pp. 298.
- YONZON, P.B. & M. HUNTER (1991): Conservation of the Red panda, *Ailurus fulgens*. *Biological Conservation* 59: 1-15.

